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Beecher, II et al.

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[45] **Dec. 19, 1978**

[54] **CAM ACTUATED MULTIPLE CONTACT SPRING SWITCH**

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[73] Assignee: **Bell Telephone Laboratories, Incorporated,** Murray Hill, N.J.

[21] Appl. No.: **790,461**

[22] Filed: **Apr. 25, 1977**

[51] **Int. Cl.**[2] **H01H 1/28;** H01H 9/00

[52] **U.S. Cl.** ..... **200/1 A;** 200/5 E; 200/153 LA; 200/159 A; 200/283; 200/314

[58] **Field of Search** ..... 200/1 A, 1 TK, 5 E, 200/5 EA, 5 EB, 6 B, 6 BA, 6 BB, 38 B, 38 BA, 38 C, 38 CA, 153 L, 153 LA, 159 A, 245, 246, 247, 283, 314, 340, 159 B; 197/102, 103

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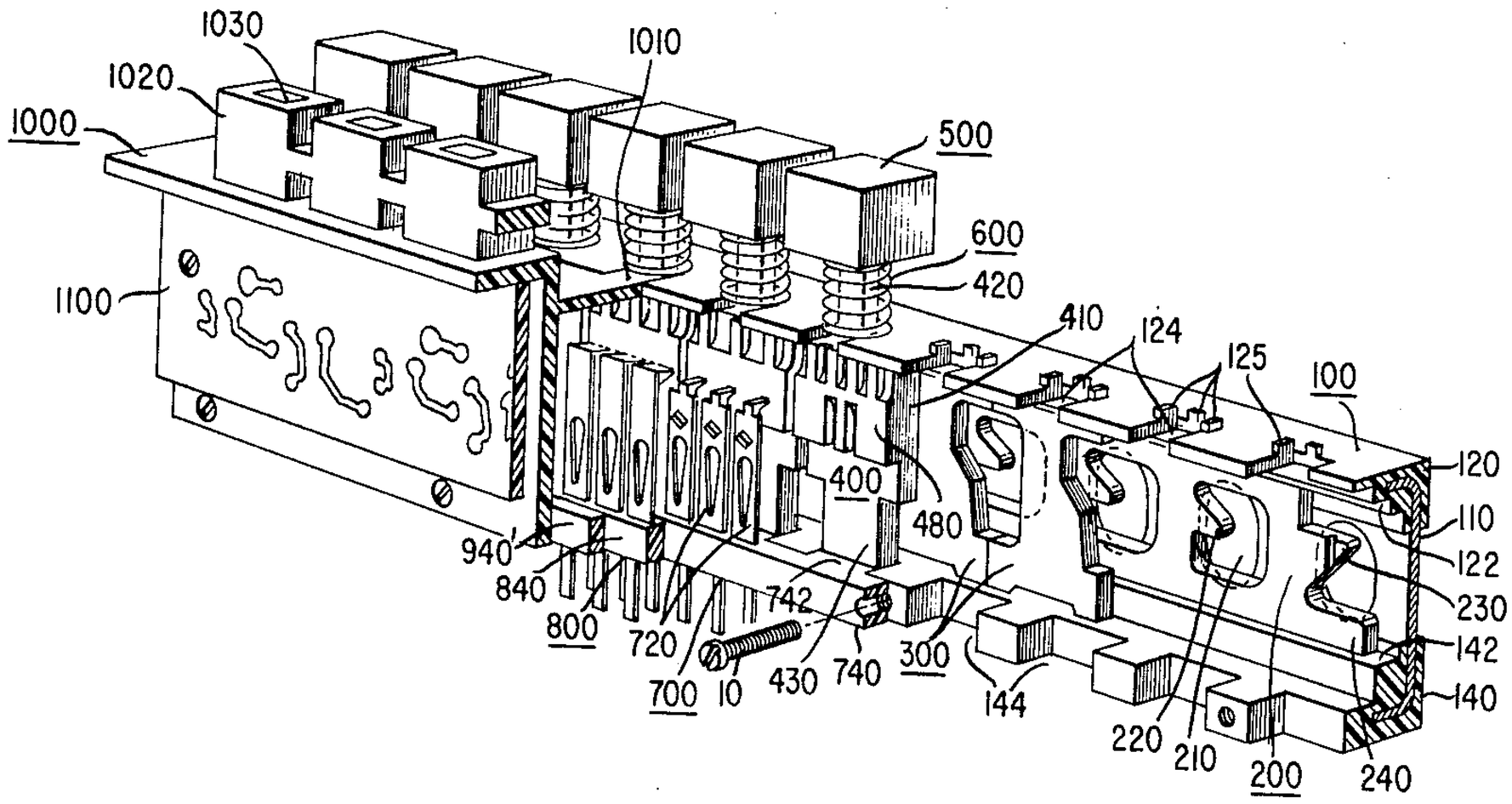
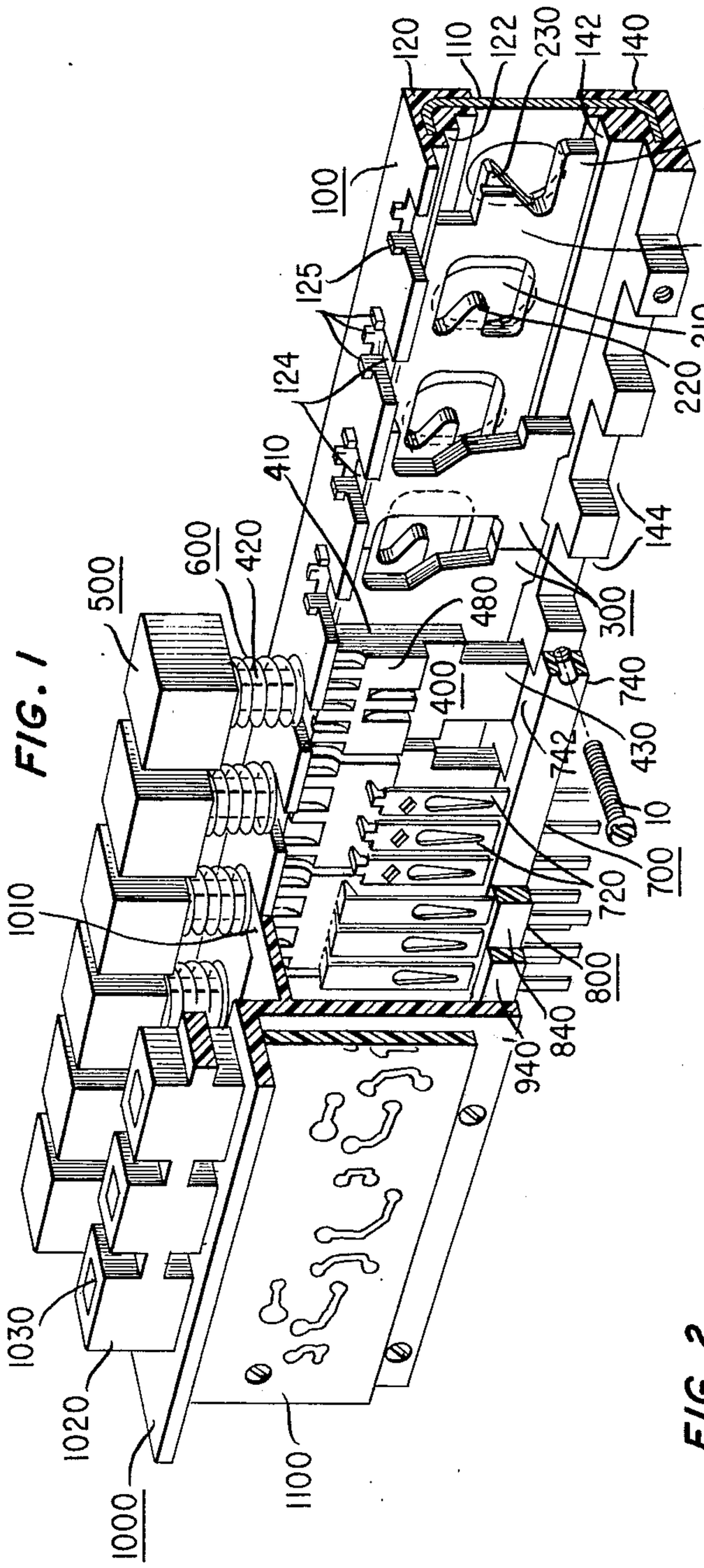
Primary Examiner—James R. Scott
Attorney, Agent, or Firm—Harry L. Newman

[57] **ABSTRACT**

A switch is disclosed in which manual adjustment of a contact spring pileup is avoided by closely controlling the interaction between (1) the contact springs, (2) a movable actuator including a plurality of cam surfaces, each of which is associated with an individual contact spring, and (3) a frame for supporting the actuator. This is achieved by molding a cam follower to one end portion and a mounting element to the other end portion of each contact spring. The mounting elements of the contact springs are positioned in engagement with one another and are secured to the frame. The mounting elements serve to orient the contact springs at a particular angle with respect to one another and accurately locate the contact springs and thereby the cam followers with respect to the cam surfaces of the actuator. The cam followers in combination with the associated cam surfaces serve to locate and provide a predetermined bias to the contact springs.

13 Claims, 11 Drawing Figures

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110
122
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200
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220
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144
600
420
300
500
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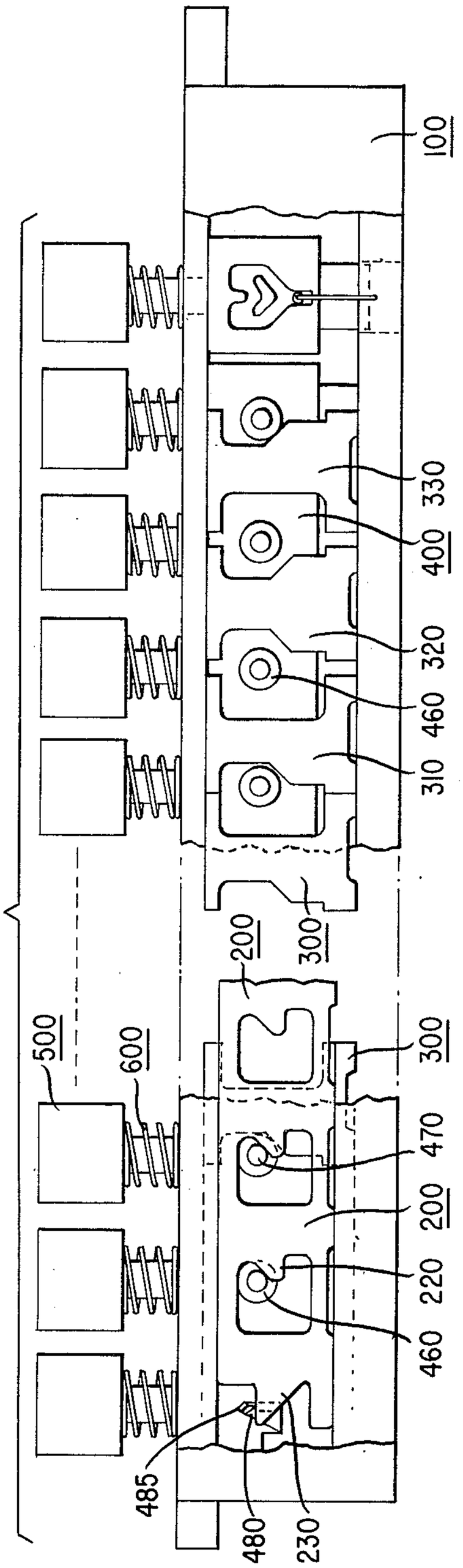
742
430
10
700
720
1010
800
840
940
1030
1020
1000
1100

FIG. 1


100
330
400
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310
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200
500
600
300
470
200
220
460
485
480
230

FIG. 2

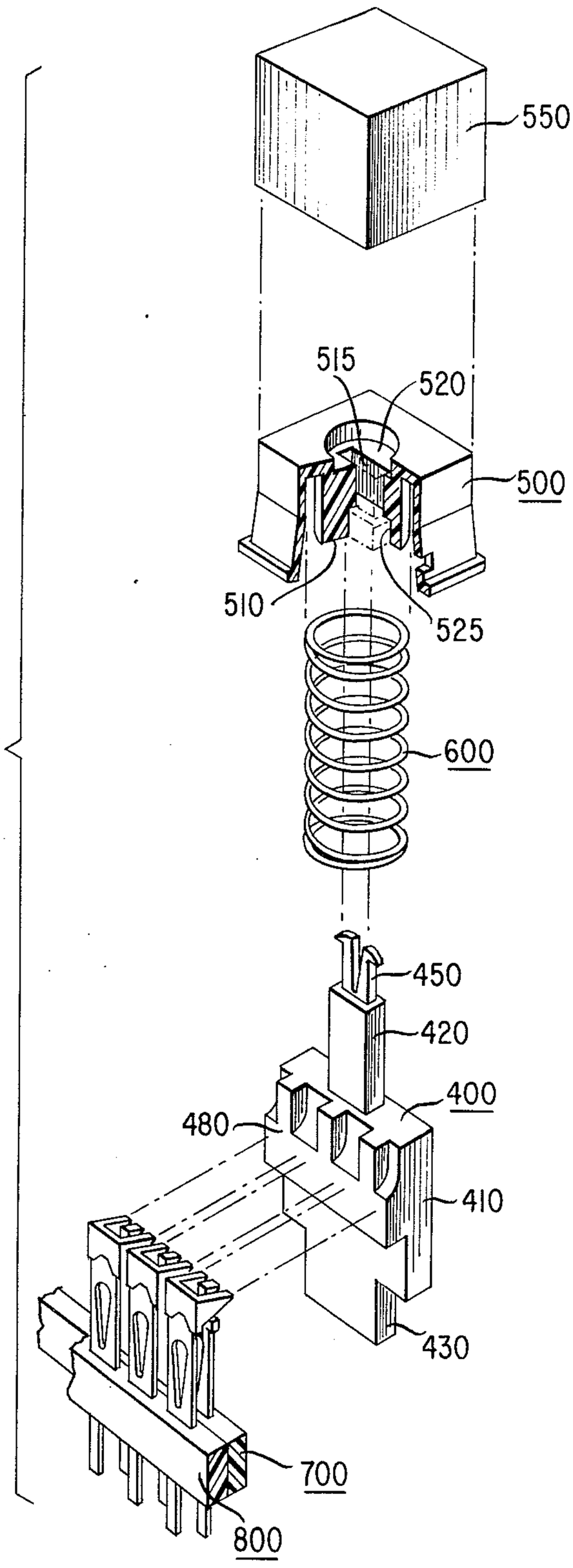
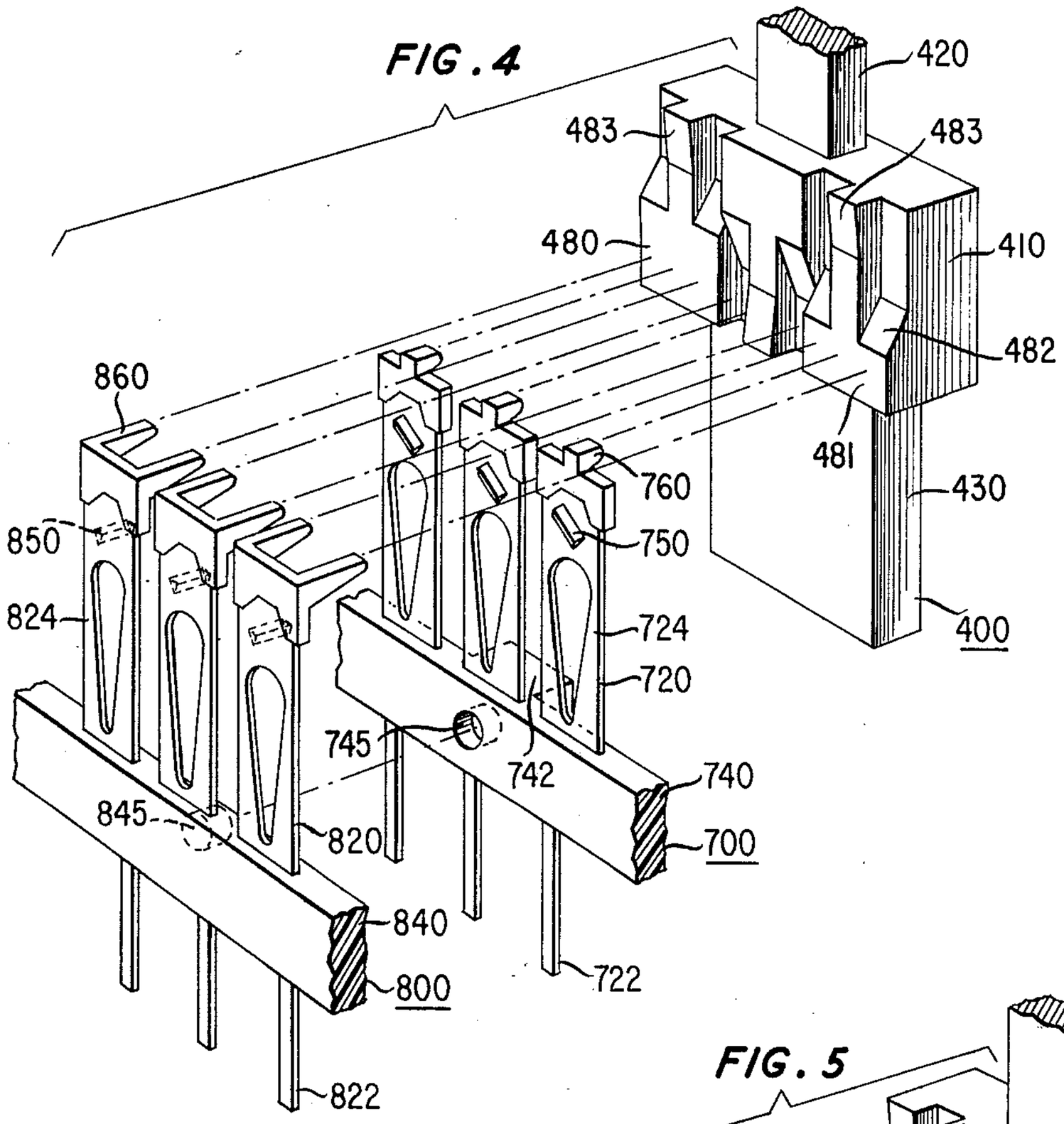


FIG. 3

FIG. 4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483
483
480
410
482
860
481
760
430
850
750
824
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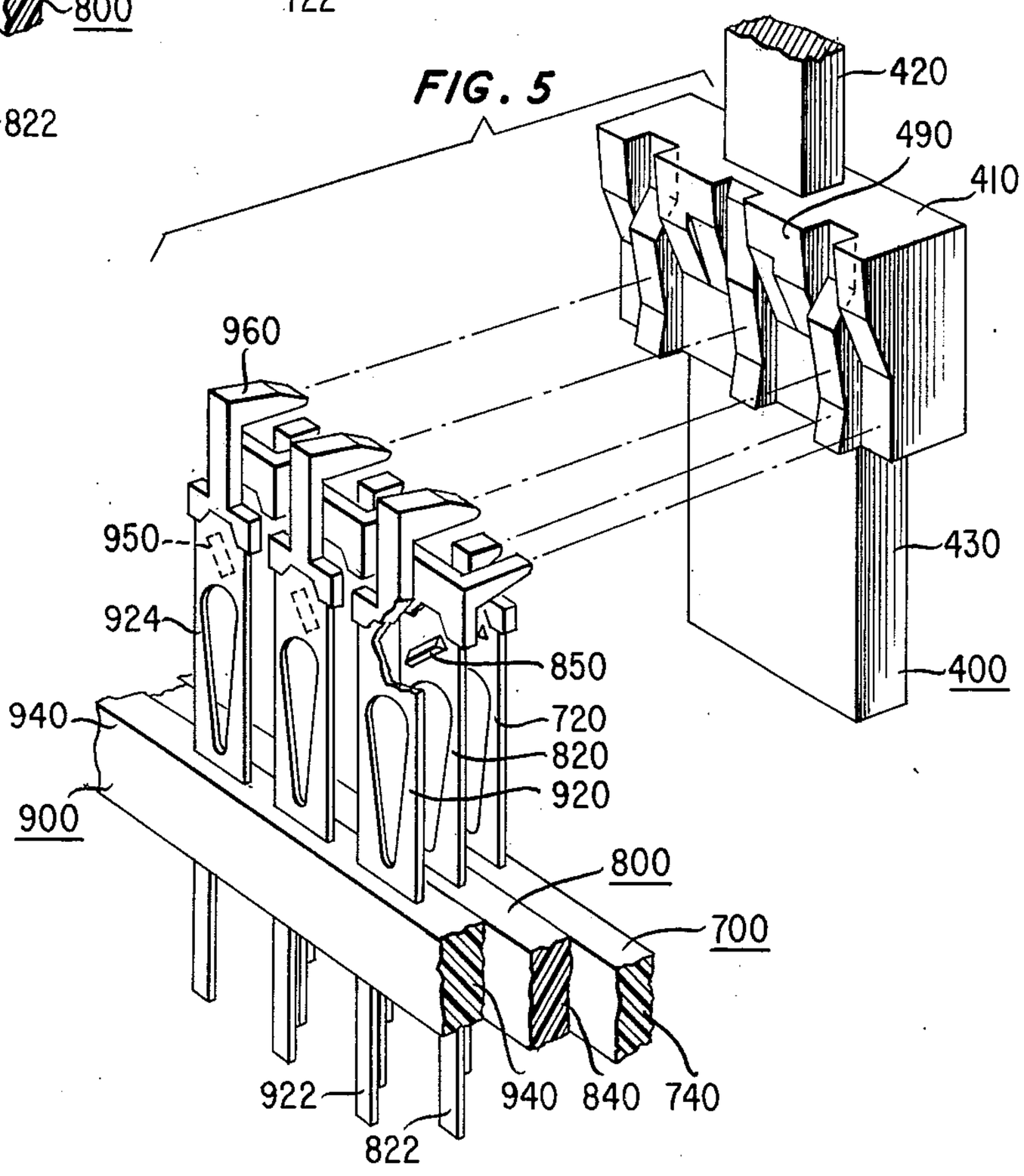
400
720
745
742
740
845
820
700
840
800
722
822

FIG. 5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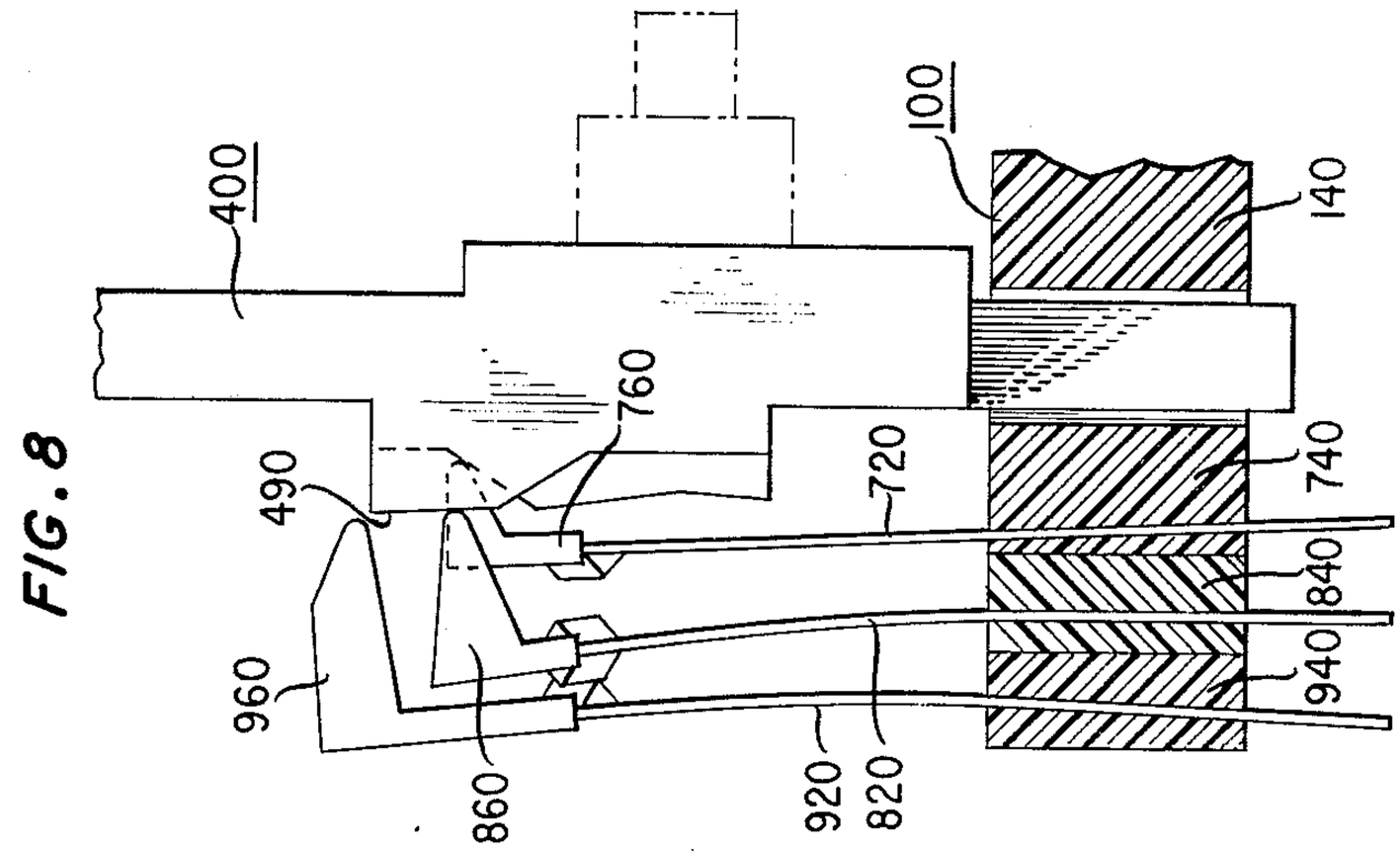

FIG. 8

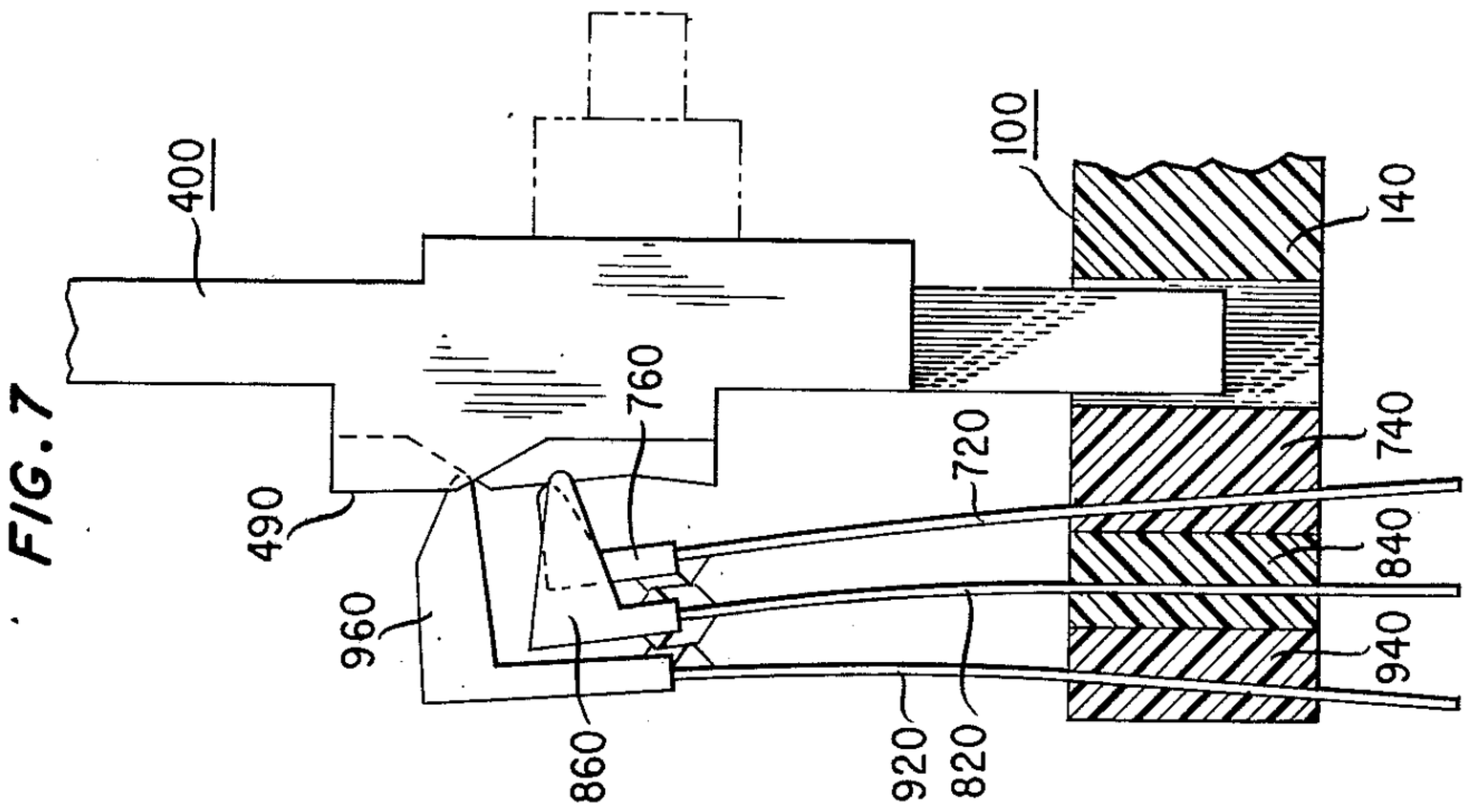

FIG. 7

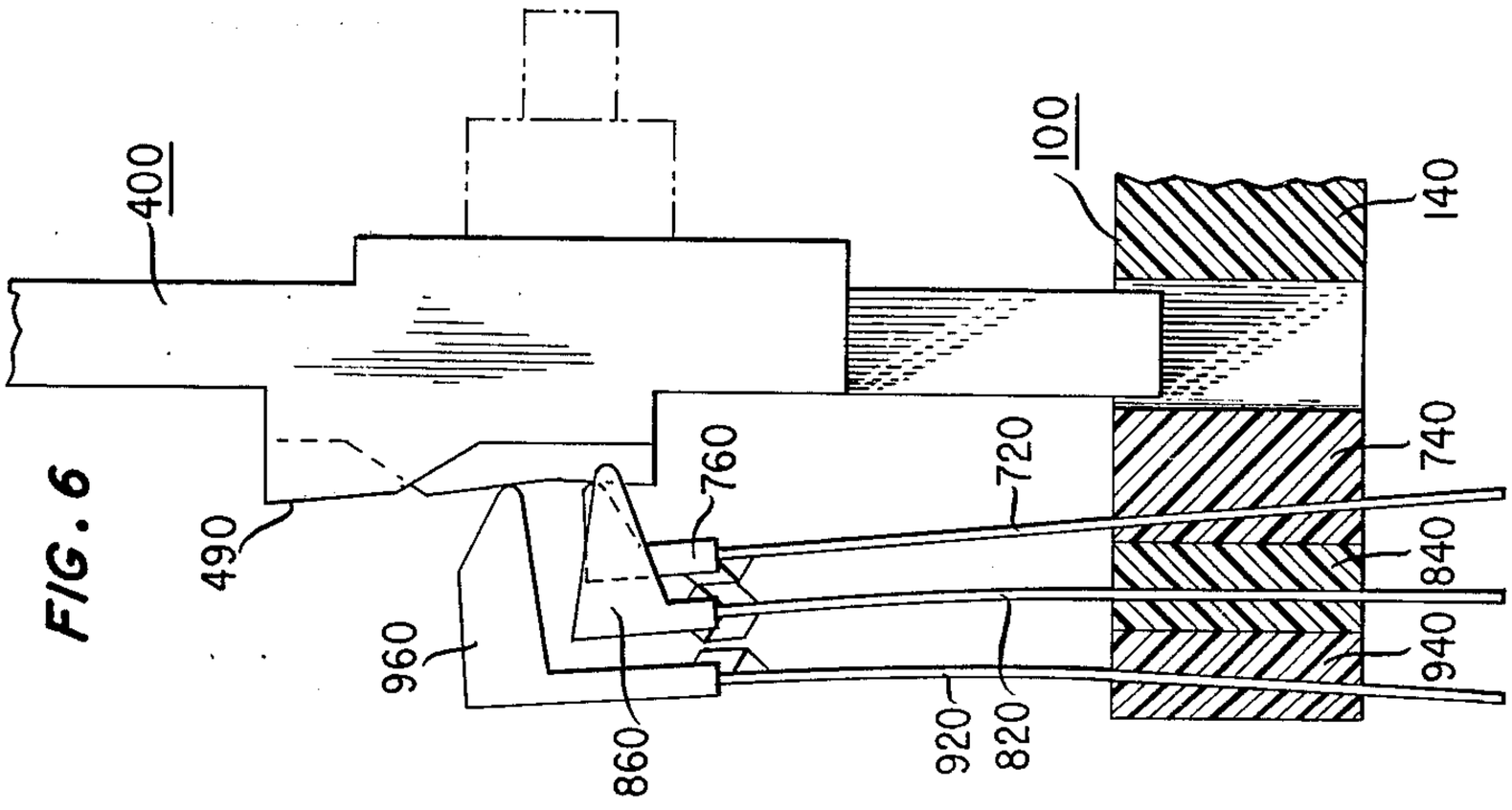

FIG. 6

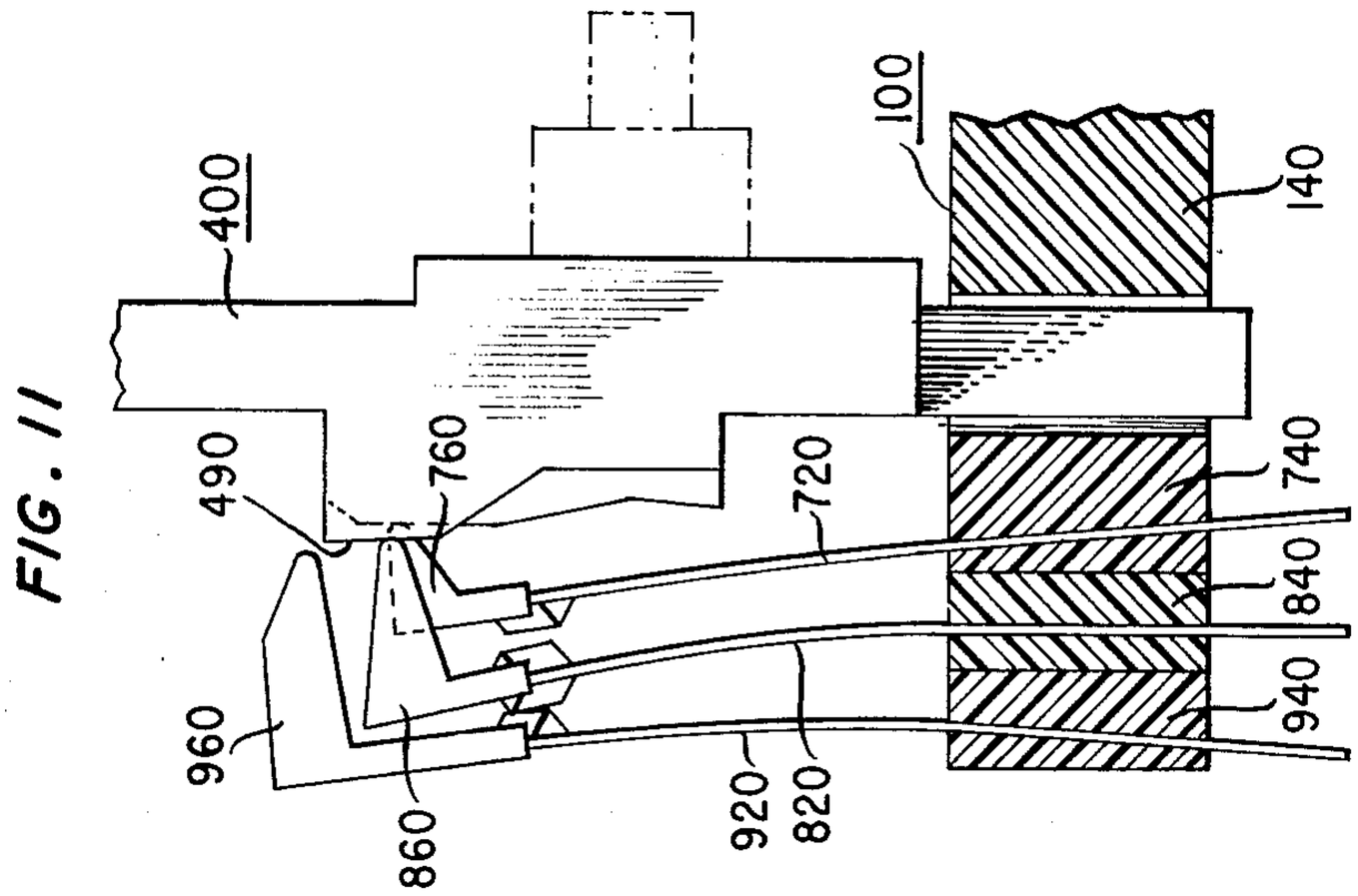

FIG. 11

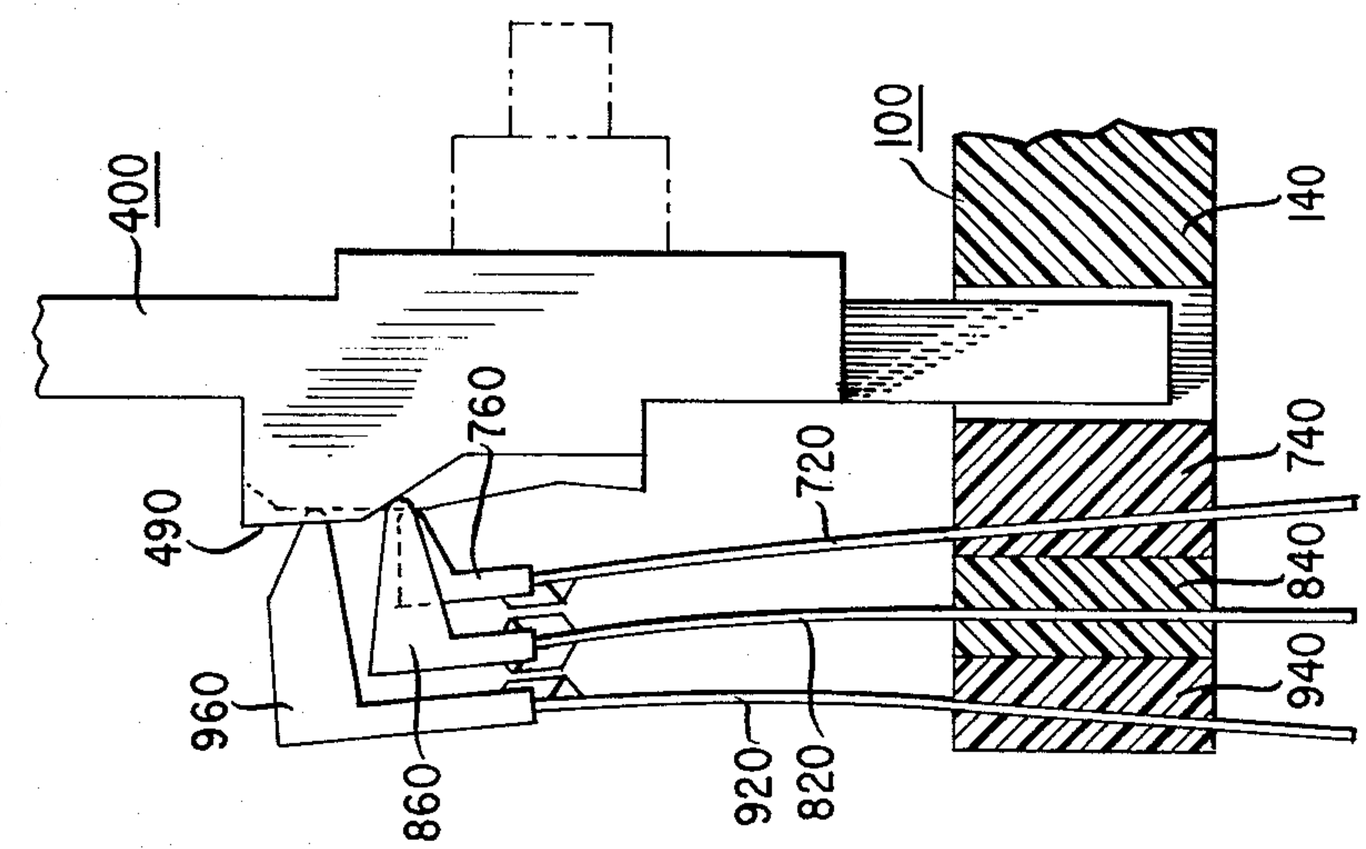

FIG. 10

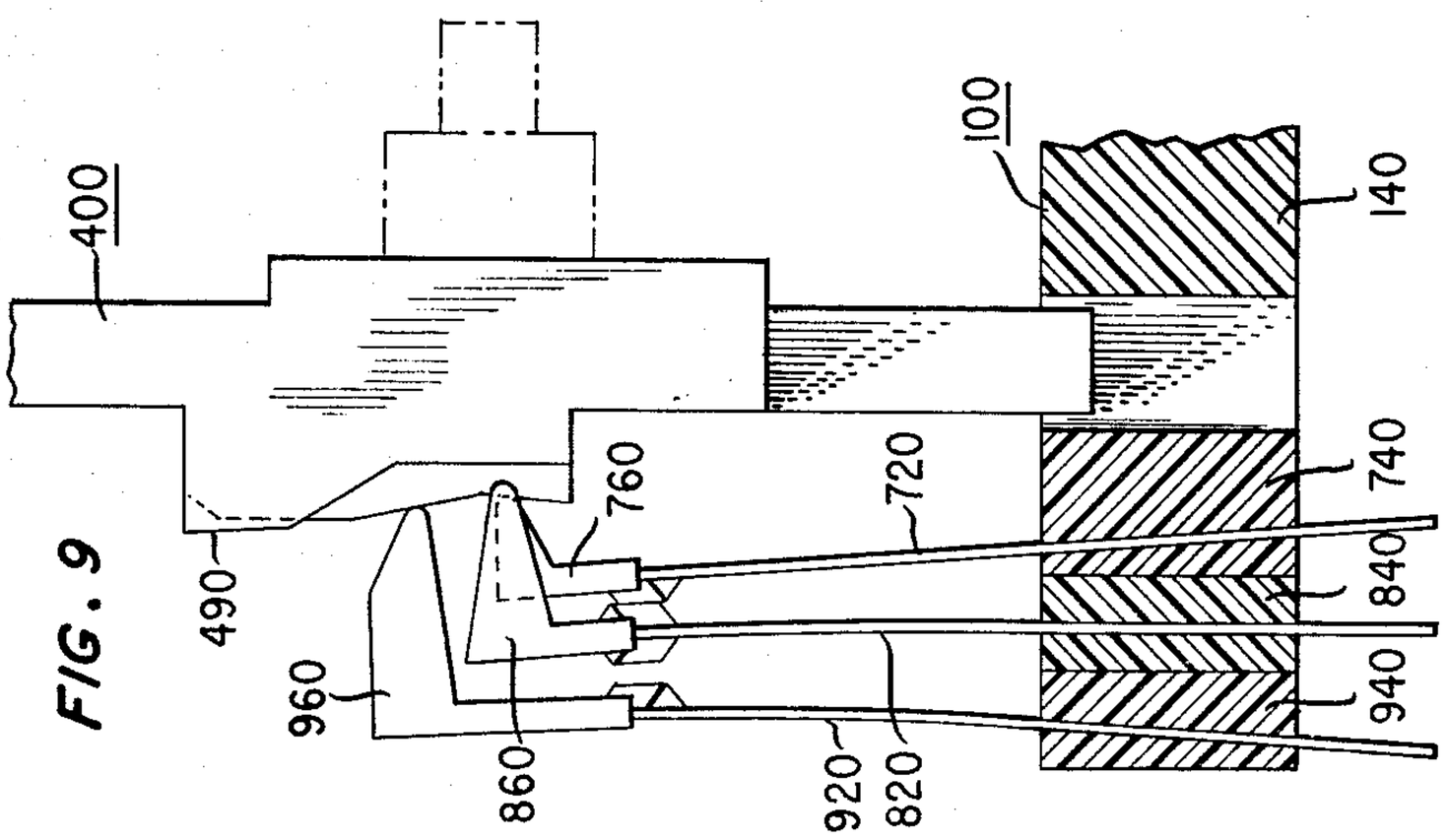

FIG. 9

CAM ACTUATED MULTIPLE CONTACT SPRING SWITCH

FIELD OF THE INVENTION

This invention relates to the field of switches and within that field to a cam actuated multiple contact spring switch.

BACKGROUND OF THE INVENTION

A significant problem in the mass production of a multiple contact spring switch is the difficulty of consistently obtaining, (1) the design spacing between contact springs when the switch is open, (2) the design timing of the closure of the contact springs relative to the movement of an associated actuator, and (3) the design contact force when the switch is closed.

Illustrative of the problem is the transfer switch disclosed in Baldasare Pat. No. 3,177,207. The switch comprises a movable cantilever contact spring that is situated between two stationary cantilever contact springs. The lower ends of the contact springs are interleaved with insulating separators and secured to a mounting strip. The upper ends of the stationary contact springs are free-standing and are deformed to extend at an angle to the lower ends. The upper end of the movable contact spring is tied to an actuator spring by an insulating spacer, and the actuator spring is itself biased against a cam surface on a pushbutton plunger. The pushbutton plunger is linearly displaceable between two positions, and the interaction between the actuator spring and the cam surface is such that in one position of the pushbutton plunger, the movable contact spring is in engagement with a first of the stationary contact springs and spaced from the second stationary contact spring. In the other position of the pushbutton plunger, the location of the movable contact spring is reversed.

The upper and lower ends of the pushbutton plunger are respectively slidably supported on a bearing bar and a bottom strip, which are discrete elements that are joined to one another by other discrete elements. In addition, the mounting strip to which the contact springs are secured is in turn secured to the bottom strip. Thus it is seen that the location of the movable contact spring with respect to the stationary contact springs varies from switch to switch in accordance with tolerance variations in the pushbutton plunger, the bearing bar, the bottom strip, the mounting strip, the actuator spring, the plurality of insulating separators, the insulating spacer, and the movable and stationary contact springs. Therefore, if the switch is manufactured on a mass production basis, it is exceedingly difficult to obtain consistency of spacing, contact force, and timing, and manual adjustment of the contact springs is necessary after they are assembled.

An improvement over this arrangement is disclosed in Stow et al. U.S. Pat. No. 3,626,131. Stow discloses a pushbutton switch comprising a hollow case having a collar within which a pushbutton plunger is slidably displaceable. The case is snap-mounted to a base having a pair of cantilever contact springs mounted thereon and the free ends of the contact springs are respectively biased against individual cam surfaces on the plunger. The cam surfaces are arranged such that the contact springs are normally separated, but when the plunger is depressed, one of the springs is deflected outwardly into engagement with the other contact spring. Thus the switch has fewer elements than that of Baldasare, resulting in less tolerance buildup, and the position of the contact springs with respect to one another is determined by the cam surfaces on the plunger.

However, both contact springs have a convoluted configuration. A first of the contact springs comprises a bent bearing end for engaging the cam surface, an inclined stem section, a horizontal mounting section, and a vertical terminal section. The other contact spring comprises a horizontal contact section that overlies the stem section, a horizontal mounting section, and a vertical terminal section. The convoluted shapes of the contact springs require a number of forming operations and each such operation introduces another tolerance variation from spring to spring. As a result, it is likely that manual adjustment of the contact spring is necessary if there is to be a consistency between switches in the contact force and in the timing of the closure responsive to the actuation of the plunger.

SUMMARY OF THE INVENTION

In the switch of the present invention, manual adjustment of the contact springs is avoided by closely controlling the interaction between, (1) the contact springs, (2) a movable actuator including an individual cam surface associated with each contact spring, and (3) a frame for supporting both the actuator and the contact springs. This close control is achieved by using contact springs that have a rectilinear form and have a cam follower molded to one end portion and a mounting element molded to the other end portion thereof. This close control is further achieved by a frame comprising a rigid metal channel having locating details molded to the upper and lower extremities thereof.

The actuator is displaceably supported on the locating details, while the mounting elements of the contact springs are stacked on the lower locating details of the frame and keyed to one another and to the lower locating details. The frame provides a very accurate support for the actuator and the contact springs, and the mounting elements of the contact springs serve to orient the contact springs at a particular angle with respect to one another and accurately locate the contact springs and thereby the cam followers with respect to the cam surfaces of the actuator. As a result, the spacing between the contact springs, the contact force, and the timing of the switching are all accurately controlled.

BRIEF DESCRIPTION OF THE DRAWING

FIG. 1 is a front perspective view of a multibutton key incorporating an exemplary embodiment of the switch of the present invention, parts of the key being broken away to expose the components of the key;

FIG. 2 is a rear view of the key with parts also broken away;

FIG. 3 is an exploded perspective view of a pushbutton actuator of the key and an associated pair of contact spring assemblies;

FIG. 4 is an exploded perspective view on a larger scale than FIG. 3 illustrating the relationship between cam followers on the contact springs and cam surfaces on the actuator;

FIG. 5 is an exploded perspective view showing the addition of a third contact spring assembly to the contact spring assemblies of FIG. 4 and showing cam surfaces on the actuator adapted for interacting with three contact spring pileups;

FIGS. 6 through 8 are enlarged sectional views showing the sequential interaction between the three

contact spring pileup and associated cam surfaces configured to provide a make before break transfer switch; and

FIGS. 9 through 11 are enlarged sectional views showing the sequential interaction between the three contact spring pileup and associated cam surfaces configured to provide a break before make transfer switch.

DETAILED DESCRIPTION

Referring to FIG. 1 of the drawing, a multi-pushbutton key incorporating a switch exemplary of the present invention includes a frame 100 comprising a U-shaped rigid metal channel 110 having an upper locating element 120 and a lower locating element 140 respectively molded to the extremities thereof. The locating elements 120 and 140 extend generally parallel to one another and respectively include opposed stepped surfaces 122 and 142 that define individual slots for accommodating a latch bar 200 and a plurality of lockouts 300. In addition, the locating elements 120 and 140 respectively include a plurality of uniformly spaced notches 124 and 144 that are aligned with one another.

As indicated in FIG 1, the latch bar 200 comprises a planar ribbon-like member having a plurality of uniformly spaced and identically shaped openings 210 therein. The center-to-center spacing of the openings 210 is the same as that of the aligned pairs of notches 124 and 144 in the frame 100, and the surface on the left side of each opening includes a nose portion 220, the upper surface of which is inclined and the lower surface of which is generally horizontal. However, the shaped opening 210 adjacent to the right end of the latch bar 200 is absent and an inverted nose portion 230, comprising a horizontal upper surface and an inclined lower surface, is provided in place of the nose portion 220.

The latch bar 200 is slidably displaceable along the lower surface of the slot in the frame 100 in which it is accommodated, and a spring (not shown) biases the latch bar toward the right whereby a stop on the latch bar is normally in engagement with an abutment (not shown) on the frame. In this position of the latch bar 200, each nose portion 220 and inverted nose portion 230 is positioned adjacent to an aligned pair of notches 124 and 144 in the frame 100.

The lockouts 300 are basically rectangular planar members having a height that is slightly less than that of the slot within which they are accommodated and having a width that is approximately the same as the center-to-center spacing of the aligned pairs of notches 124 and 144.

As shown in FIG. 2, the lockouts 300 have three different shapes indicated as 310, 320 and 330, but they are of two basic types, full lockouts and half lockouts. The lockout 320 is a full lockout in that both of its sides are relieved between the upper and lower extremities thereof to provide a recess adjacent to its upper end that leads into a downwardly and outwardly extending shoulder adjacent to its lower end. The lockouts 310 and 330 are, on the other hand, half lockouts in that just one of their sides has the foregoing configuration, while the other of their sides has a recess that is continuous between the upper and lower extremities of the side. The lockouts 310 and 330 are identical and are assembled opposite and into the identical frame 100.

Referring again to FIG. 1, the latch bar 200 and lockouts 300 interact with a plurality of reciprocally displaceable planar actuators 400 respectively associated with the aligned pairs of notches 124 and 144 in the frame 100. Each actuator 400 includes a wide body portion 410 having a narrow upper guide portion 420 upstanding therefrom a narrow lower guide portion 430 depending therefrom. The body portion 410 is positioned between the locating elements 120 and 140, while the upper and lower guide portions 420 and 440 respectively extend within the associated pair of notches 124 and 144. The upper and lower guide portions 420 and 440 are of a slightly lesser width than the notches with which they are associated, and the surfaces of the notches serve as bearings for directing the movement of the actuators 400 along a rectilinear path. The movement of each actuator 400 is limited by the engagement of its body portion 410 with the upper and lower locating elements 120 and 140.

As shown in FIG. 3, a catch portion 450 extends from the end of the upper guide portion 420 and serves to secure a rectangular button 500 to the actuator 400. The catch portion 450 comprises a pair of inverted L-shaped flexible elements having upwardly extending legs terminated by laterally and oppositely extending feet. The button 500 with which the catch portion 450 interacts comprises an inverted cup-shaped member having a depending cylindrical portion 510 in the center thereof through which an opening 515 extends. The catch portion 450 is inserted into the lower end of the opening 515, and the opening is of a width to deflect the flexible elements toward one another. In addition, the height of the opening 515 is such that the laterally extending feet move out of the upper end of the opening into a recess 520 in the top of the button at the same time that the upper guide portion 420 seats within a conforming recess 525 in the bottom of the cylindrical portion 515. The flexible elements 450 thereupon return to their normal spaced position, whereby the feet move over the bottom surface of the recess 520 and secure the button 500 to the actuator 400. A transparent cap 550 that telescopes over and snap mounts to the button 500 serves to retain a designation label (not shown) in place on the button.

Referring to FIGS. 1 and 3, a helical compression spring 600 disposed about the upper guide portion 420 biases the actuator 400 toward its upper position. The spring 600 is captured between the button 500 and the upper locating element 120 of the frame 100, and the upper end of the spring extends within the button and encompasses the depending cylindrical portion 510 thereof. The lower end of the spring 600, on the other hand, embraces a plurality of bosses 125 protruding from the top surface of the upper locating element 120, an individual boss being positioned on each side of the associated notch 124. These components cooperate to maintain the spring 600 in alignment with the linear path of displacement of the actuator 400.

The plurality of actuators 400 serve to retain the latch bar 200 and lockouts 300 within their respective slots in the frame 100, and as shown in FIG. 2, the adjacent side of the body portions 410 of most of the actuators includes a disk 460 having a coaxial pin 470 extending therefrom. Each disk 460 extends into the slot in the frame 100 within which the lockouts 300 are accommodated, and the dimensions of the disk and of the lockouts are such that the following relationships exist.

When an actuator 400 is in its upward position, the disk 460 thereon is situated within the recess of an adjacent lockout 300. As the actuator 400 is depressed, the shoulder on an associated lockout 300 may be in the path of the disk 460 in which case that lockout and all

other abutting lockouts are deflected laterally away from the disk, a distance that places the shoulder of the other lockouts in the paths of the disks on their associated actuators. If a pair of actuators **400** straddling a full lockout **320** are simultaneously depressed, the disks **460** on the actuators engage the shoulders of the lockout and the actuators are unable to move to their downward position. However, if a pair of actuators **400** straddling a half lockout **310** or **330** are simultaneously depressed, the half lockout may be deflected laterally by the engagement of its shoulder by the associated disk **460**, but both actuators are able to move to their downward position.

As a result of these relationships, with lockouts arranged in the manner shown in FIG. **2**, all of the actuators **400** straddling the half lockouts **310** may be moved to their lower position in any combination simultaneously. Similarly, the actuators **400** straddling the half lockout **330** may be moved to their lower position simultaneously. However, because of the full lockout **320**, none of the actuators **400** straddling the half lockouts **310** may be moved to their lower position at the same time as the actuators straddling the half lockouts **330**.

The pin **470** extending from each disk **460** extends into the adjacent opening **210** in the latch bar **200**, and when the latch bar is in its normal position and the actuator **400** is in its upward position, the associated pin overlies the nose portion **220** at the side of the opening. Thus when the plunger **400** is depressed, the pin **470** engages the inclined surface of the nose portion **220** and deflects the latch bar **200** toward the right. The pin **470** continues to deflect the latch bar **200** to the right until the pin moves past the end of the nose portion **220**. When this occurs, the biasing spring returns the latch bar **200** to its normal position, and the horizontal surface of the nose portion **220** is moved over the pin **470**, latching the actuator **400** in a downward position.

When another actuator **400** having a pin **470** is subsequently depressed, the latch bar **200** is again deflected to the right, and when the pin of the second actuator reaches the end of the inclined surface of the associated nose portion **220**, the latch bar is deflected to a position wherein the pin on the first actuator is no longer beneath the horizontal surface of its associated nose portion. The spring **600** associated with the first actuator **400** thereupon moves the actuator to its upward position.

The actuator **400** on the far left, as viewed in FIG. **2**, has a U-shaped spring member **480** instead of the disk **460** and pin **470**. A first leg of the spring member **480** is secured to this actuator **400** while the second leg extends in a generally vertical plane spaced from the actuator, the free end of the second leg being deflectable in a generally horizontal plane. In addition, the second leg terminates in an inclined triangular flange **485** that overlies the nose portion **230** of the latch bar **200** when the latch bar is in its normal position and this actuator **400** is in its upward position.

When this actuator **400** is depressed, the flange **485** on the spring member **480** engages the horizontal surface of the nose portion **230** and is deflected behind the nose portion, moving the second leg toward the actuator. As this plunger **400** continues to move downward, the flange remains behind the nose portion **230** until the actuator is depressed far enough to move the flange below the inclined surface of the nose portion. When this occurs, the second leg moves out from this actuator **400** and the flange **485** underlies the inclined surface of the nose portion **230**.

Thereafter when this actuator **400** is permitted to move upward under the bias of its associated spring **600**, the flange **485** on the spring member **480** engages the inclined surface of the nose portion **230** and deflects the latch bar **200** to the right. It continues to deflect the latch bar **200** to the right until it reaches the end of the inclined surface, at which point the latch bar has moved far enough to the right to move the horizontal surface of the nose portion **220** out of the path of the pin **470** on a previously depressed actuator **400**. The previously depressed actuator **400** then moves to its upward position under the bias of its associated spring **600**.

From the foregoing it is seen that when any of the actuators **400** having a pin **470** is moved to its downward position, it is latched in that position, and any previously latched actuator is released. When the actuator **400** on the far left is moved to its downward position, it is not latched in that position, and as it returns to its upward position, it releases any previously latched actuator.

Turning again to FIG. **1**, the side of each actuator **400** facing away from the latch bar **200** includes a cam surface **480** on the body portion **410** that interacts with a pair of contact spring assemblies **700** and **800**. The contact spring assembly **700** comprises a multiplicity of identical rectilinear contact springs **720** having a common mounting element **740** molded thereon in the proximity of the lower end thereof. The mounting element **740** serves to locate the contact springs **720** side by side and equally spaced from one another in a common plane. In addition, the mounting element **740** serves to locate the contact springs **720** with respect to the actuators **400**, three side by side contact springs being associated with each actuator.

The mounting element **740** has a plurality of rectangular protrusions **742**, one of which is shown, that are equal in number to and respectively accommodated within the notches **144** in the locating element **140** of the frame **100**. The protrusions **742** locate the contact spring **720** laterally with respect to the direction of movement of the actuators **400** and also provide bearing surfaces for the lower quide portions **430** of the actuators. Other protrusions (not shown) on the mounting element **740** interact with cavities (not shown) in the lower locating elements **140** to locate the contact springs **720** parallel to the direction of movement of the actuators **400**. Finally, the portions of the mounting element **740** between the protrusions **744** are placed in direct engagement with and fastened to the portions of the locating element **140** between the notches **144**. The mounting element **740** thereby orients the contact springs **720** at a particular angle with respect to the actuators **400**. As shown most clearly in FIGS. **6–10**, the mounting element **740** is molded on the contact springs **720** so that when it is secured to the locating element **140**, the contact springs lie in a plane that extends obliquely with respect to the path of movement of the actuators **400**, the upper ends of the contact springs extending away from the actuators.

Referring now to FIG. **4**, the portion of each contact spring **720** depending from the mounting element **740** comprises an offset terminal **722**, while a cantilever portion **724** extends upwardly from the mounting element. A precious metal contact **750** is bonded to each cantilever portion **724** on the surface facing away from the associated actuator **400**, while an identical cam fol-

lower **760** is molded to the free end of each cantilever portion. Each cam follower **760** has a wedge-shaped profile and extends toward the associated actuator **400**. In addition, each cam follower **760** is centered between the sides of the cantilever portion **724** and occupies less than a third of its width.

The contact spring assembly **800** is similar to the contact spring assembly **700** in that it includes a multiplicity of contact springs **820** having a common mounting element **840** molded thereon in the proximity of the lower end thereof. The mounting element **840** locates the contact springs **820** side by side in a common plane with the same spacing as the contact springs **720**. Furthermore, the mounting element **840** is positioned in direct engagement with the mounting element **740** and has a plurality of pins **845**, one of which is shown, that are respectively accommodated in conforming cavities **745**, one of which is shown, in the mounting element **740** to accurately locate the mounting element **840** with respect to the mounting element **740**.

The contact springs **820** are thereby accurately located both laterally, vertically and at a particular angle with respect to the actuators **400** and the contact springs **720**. The mounting element **840** locates the contact springs **820** in alignment with the contact springs **720** and, as shown in FIGS. **6–10**, in a plane that extends generally parallel to the path of movement of the actuators **400**. This orientation of the contact springs **820** places the upper end of each in close proximity with the upper ends of an individual contact spring **720**.

Each contact spring **820** includes a depending terminal **822** that is offset opposite to the terminals **722** of the contact springs **720**. In addition, each contact spring **820** includes an upstanding cantilever portion **824** having a precious metal contact **850** bonded thereto on the surface facing and in a position to engage the contact **750** on the cantilever portion **724** of the aligned contact spring **720**. Finally, the free end of each cantilever portion **824** has an identical bifurcated cam follower **860** molded thereto that extends toward the associated actuator **400** and straddles the cam follower **760** on the cantilever portion **724** of the aligned contact spring **720**.

It is seen from the lines drawn from the cam followers **760** and **860** to the cam surfaces **480** on the body portion **410** of the associated actuator **400** that the cam followers on each aligned pair of contact springs **720** and **820** interacts with an individual group of cam surfaces. When the actuator **400** is in its upward position, which is the position shown in FIG. **4**, the cam followers **760** and **860** on the cantilever portions **724** and **824** of the right-most pair of contact springs **720** and **820** engage a common vertical cam surface **481**. The configuration of the cam followers **760** is such that in this position the cantilever portion **724** is deflected from its unstressed position a distance sufficient to generate the spring force necessary to assure engagement of the cam follower with the cam surface. In addition, the configuration of the cam follower **860** is such that when it and the cam follower **760** are in engagement with a common cam surface, the cantilever portion **824** is deflected a distance sufficient to provide a preselected separation between its contact **850** and the contact **750** on the contact spring **720**.

When the actuator **400** is moved downward, the cam follower **860** moves from the vertical cam surface **481** to a rearwardly inclined cam surface **482**. The cantilever portion **824** of the contact spring **820** is thereby permitted to move rearward and the configuration of the cam surface **482** is such that the contact spring **820** moves its contact **850** into engagement with the mating contact **750** on the cantilever portion **724** of the contact spring **720** before the cam follower **860** reaches the upper-most end of the cam surface **482**. Thus as the downward movement of the actuator **400** continues, the rearward movement of the cantilever portion **824** is arrested by the engagement of the contacts **750** and **850**, and the cam surface **482** separates from the cam follower **860**. In this position of the cantilever portion **824** it is deflected from its unstressed position a distance sufficient to provide at least the minimum contact force necessary to provide a low resistance path between the contact springs. Thereafter, the cam follower **760** moves into engagement with the forwardly inclined cam surface **483**, and both cantilever portions **724** and **824** are deflected forwardly. This forward deflection results in an increase in contact force above the above-noted minimum and in relative movement between the contact springs **720** and **820** to provide a wiping of the engaging surfaces of the contacts **750** and **850**.

It is seen that the cam surfaces **480** engaged by the cam followers **760** and **860** on the left-most pair of contact springs **720** and **820** are basically the same as the ones just described. The only difference is that the surface equivalent to the cam surface **482** is displaced upwardly. Thus, the right-most and left-most contact spring pairs **720** and **820** both provide normally open switches, but the right-most contact spring pair closes before the left-most contact spring pair. The cam surfaces **480** engaged by the cam followers **760** and **860** of the middle pair of contact springs **720** and **820** are, on the other hand, the inverse of the ones just described. The middle pair of contact springs **720** and **820** are therefore normally closed and its associated cam surfaces **480** are arranged so that it opens after the right-most pair of contact springs close and before the left-most pair of contact springs close. Consequently, by strapping together the terminals **722** of the right-most and middle contact springs **720**, a make before break transfer sequence is provided, and by strapping together the terminals of the middle and left-most contact springs **720** a break before make transfer sequence is provided.

However, if more than one transfer sequence is necessary responsive to the movement of the actuator **400**, then as shown in FIG. **5**, contacts **850** are bonded to both surfaces of the cantilever portions **824** of the contact springs **820** and a third contact spring assembly **900** is provided. The contact spring assembly **900** is similar to the contact spring assemblies **700** and **800** in that it includes a multiplicity of contact springs **920** having a common mounting element **940** molded thereon in the proximity of the lower end thereof. The mounting element **940** locates the contact springs **920** side by side in a common plane with the same spacing as the contact springs **720** and **820**. Furthermore, the mounting element **940** is positioned in direct engagement with the mounting element **840** and has a plurality of pins (not shown) that are respectively accommodated in conforming cavities (not shown) in the mounting element **840** to accurately locate the mounting element **940** with respect to the mounting element **840**. The contact springs **920** are thereby accurately located both laterally, vertically, and at a particular angle with respect to the actuators **400** and the contact springs **720** and **820**. The mounting element **940** locates the contact springs **920** in alignment with the contact springs **720** and **820** and, as shown in FIGS. **6–10**, in a plane that

extends obliquely with respect to the path of movement of the actuators **400**, the upper ends of the contact springs extending toward the actuators.

Each contact spring **920** includes a depending terminal **922** that is offset opposite to the terminals **822** of the contact springs **820**. In addition, each contact spring **920** includes an upstanding cantilever portion **924** having a precious metal contact **950** bonded thereto on the surface facing and in a position to engage the opposing contacts **850** on the cantilever portion **824** of the aligned contact spring **820**. Finally, the free end of each cantilever portion **924** has an identical cam follower **960** molded thereon that extends toward the associated actuator **400** and is positioned above, is approximately the same width as, and is aligned with the cam follower **760** on the aligned contact spring **720**. Although as a result of the foregoing relationship it would appear that the cam followers **960** on the contact springs **920** engage essentially the same cam surfaces **490** on the actuator **400**, it is seen from FIGS. **6–8** that these cam surfaces can be arranged to provide a make before break switching sequence or, as shown in FIGS. **9–11**, a break before make switching sequence. The cam surfaces **490** on the actuator **400** shown in FIG. **5** are arranged such that the right-most and left-most groups of contact springs **720**, **820** and **920** both provide the make before break switching sequence, while the middle group of contact springs provides the break before make switching sequence.

Returning now to FIG. **1**, it is seen that the disclosed multibutton key incorporates a dummy mounting element **940'** when the third contact spring assembly is not included. In addition, it is seen that the securing of the contact springs **700** and **800** to the frame **100** provides an operative multibutton key. A plurality of fasteners **10**, one of which is shown, are threaded through the mounting elements **940'**, **840** and **740** and into the lower locating element **140** of the frame **100** to achieve this result.

If signaling lamps are to be included in the key, a unitary lamp support **1000** is also fastened to the frame **100**. The support **1000** includes a plurality of fingers **1010** that are equal in number to and have a size and spacing to extend within each of the notches **124** in the upper locating element **120** of the frame **100**. The fingers **1010** provide bearing surfaces for the upper guide portions **420** of the actuators **400**, and each finger includes an upstanding boss (not shown) that like the bosses **125** on the upper locating element **120** is embraced by the lower end of the associated spring **600**.

The support **1000** also includes a plurality of lamp chambers **1020** respectively situated adjacent to the buttons **500** on the actuators **400**. Each chamber **1020** is adapted to accommodate an individual light emitting diode (not shown), and the upper end of each chamber is closed by a lens **1030**. The leads of the light emitting diodes extend downwardly from the underside of the chambers and are advantageously electrically connected to a printed circuit board **1100** secured to standoffs on the support **1000**.

Although only a few specific exemplary embodiments of this invention have been described in detail, those in the art will appreciate that many variations and/or modifications may be made in the exemplary embodiments without in any way departing from the novel and advantageous features of this invention. Accordingly, all such variations and modifications are intended to be included within the scope of this invention as defined in the appended claims.

What is claimed is:

1. A switch comprising: a movable actuator having
a body portion on which a plurality of cam surfaces are located, and
a pair of aligned guide portions that extend oppositely from the body portion;
a frame for supporting the actuator comprising a rigid metal channel having an upper and a lower element respectively molded to the extremities thereof, the upper and lower element each including a notch, the notches being aligned with one another and accommodating the guide portions of the actuator and cooperating with the guide portions to direct the movement of the actuator; and
a first and second contact spring positioned adjacent to one another, each contact spring being associated with an individual cam surface of the actuator and at least one contact spring being deflected responsive to the movement of the actuator, each contact spring being associated with a cam follower in the proximity of one end thereof that extends into juxtaposition with the associated cam surface of the actuator and each contact spring having a mounting element molded thereon in the proximity of the other end thereof, the mounting elements of the contact springs being positioned in engagement with one another and secured to the frame and serving to orient the contact springs at a particular angle with respect to one another and with respect to the cam surfaces of the actuator, and the cam followers in combination with the associated cam surfaces serving to locate and provide a predetermined bias to the contact springs.

2. A switch as in claim **1** wherein the movement of the actuator is limited by the engagement of the body portion with the upper and lower elements of the frame.

3. A switch as in claim **1** wherein the actuator further includes an integral catch portion extending from the end of the upper guide portion for securing a button to the actuator, the catch portion comprising a pair of inverted L-shaped flexible elements having upwardly extending legs terminated by laterally and oppositely extending feet, the legs being positioned within an opening in the button and the feet engaging an upper surface of the button with the underside of the button in engagement with the upper guide portion.

4. A switch as in claim **3** wherein the feet of the flexible elements extend within a recess in the top of the button and the upper guide portion seats within a conforming recess in the underside of the button.

5. A switch as in claim **3** wherein the button comprises an inverted cup-shaped member having a depending cylindrical portion in the center thereof through which the opening extends, the upper end of a helical compression spring extends within the button and encompasses the cylindrical portion, and the lower end of the spring embraces a plurality of bosses protruding from the top surface of the upper locating element of the frame, the spring biasing the actuator upwardly.

6. A switch as in claim **1** wherein three side by side pairs of first and second contact springs interact with the cam surfaces of the actuator, two of the pairs of the contact springs being normally open and one of the pairs of contact springs being normally closed, the movement of the actuator resulting in a first pair of normally open contact springs closing before the second pair of normally open contact springs and the normally closed pair of contact springs opening after the

closing of the first pair of normally open contact springs and before the closing of the second pair of normally open contact springs.

7. A switch as in claim 6 wherein one of the contact springs of the first pair of normally open contact springs is electrically connected to one of the contact springs of the pair of normally closed contact springs to provide a make-before-break transfer switch.

8. A switch as in claim 6 wherein one of the contact springs of the second pair of normally open contact springs is electrically connected to one of the contact springs of the pair of normally closed contact springs to provide a break-before-make transfer switch.

9. A switch as in claim 1 wherein the mounting elements of the first and second contact springs orient the contact springs so that they lie in intersecting planes.

10. A switch as in claim 1 wherein the mounting element of the first contact spring includes a protrusion that is accommodated within the notch in the lower element of the frame and provides a bearing surface for the lower guide portion of the actuator.

11. A switch as in claim 1 further including a lamp support secured to the frame, the lamp support including a finger that extends within the notch in the upper element of the frame and provides a bearing surface for the upper guide portion of the actuator.

12. A switch as in claim 11 wherein the lamp support includes a lamp chamber situated adjacent to the actuator.

13. A switch as in claim 12 wherein leads of a lamp accommodated by the lamp chamber are electrically connected to a circuit board secured to the lamp support.

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